

II. REMARKS

A. Introduction

In this non-final Office Action, claims 1-6 are noted as pending and are rejected based on prior art.

In summary of this Response, claims 1, 2 and 5 are amended, and remarks are provided.

B. Objections to the Specification/Rejection of Claims Under 35 U.S.C. § 112

In regard to numbered paragraphs 1-4 of the Office Action, the Examiner's questions/requirements are addressed below.

Numbered paragraphs 1, 2, 4(partial): Table 1 on page 8 is amended to indicate that the polyol component of Example 7 is 100%, as with the remaining examples, and as with Example 7 in the parent application. Also, each instance in the written description, abstract and claims wherein "3, 9-bis[(2-{3-(3-*t*-butyl-4-hydroxy-5-methylphenyl) propionyloxy}1,1-dimethylethyl)-2,4,8,10-tetraoxapyro [5,5] undecane" appears has been replaced with "3,9-bis(1,1-dimethyl-2-(3-(3-*tert*-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane", as suggested by the Examiner. Claim 1 is also amended to indicate the phenolic antioxidants in the alternative.

Numbered paragraph 3: Claim 2 is amended to correspond to the disclosure at page 5, line 4 of the application as filed.

Numbered paragraph 4: The Examiner indicates that it is unclear what "substantially free" of dibutyl cresol means. Page 1, paragraph [0004] of the present application, states that the source of dibutyl cresol is in relation to the conventional polyol raw material. See also the Duffy et al. (USP 5,382,602) at Col. 2, lines 61-68 and Col. 3, lines 1-7. Independent claim 1 has been amended to recite "a dibutyl cresol-free polyol". See, e.g., page 2, numbered paragraph [0009], line 3, and Table 1, compare Examples 1-7 where no BHT (antioxidant "4") is used, but YI values are superior to the Comparative Examples 1-6, wherein BHT is added to the polyol.

C. Prior Art Rejection

Claims 1-6 are rejected as being made obvious by a combination of St. Clair et al., which is cited for disclosing each recited feature except the specific recited phenolic antioxidants, and Ishii et al., which is cited for teaching the use of 3,9-bis(1,1-dimethyl-2-(3-(3-*tert*-butyl-4-hydroxy-

5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane, or Duffy et al., which is cited for teaching the use of 2-2'-thio-diethylene bis (3-(3,5-di-*t*-butyl-4-hydroxyphenyl)propionate), as antioxidants for use with polyurethanes.

For the following reasons, it is respectfully submitted that the present invention, as recited by amended claims 1-6, was not rendered obvious by the cited combination.

Initially, as pointed out by the Examiner, St. Clair et al. teaches the use of relatively high molecular weight polydiene diols, i.e., 1000 to 10,000. Col. 2, line 60. In contrast, the present invention, as recited by independent claim 1, relates to only two phenolic antioxidant compounds, with inherent molecular weights of 741 and 642.9, respectively. See page 3, numbered paragraph [0015] of the application as filed. Thus, the issue is whether the prior art suggests substituting St. Clair et al.'s high molecular weight polydiene diols with the two specific lower molecular weight compounds recited. It is respectfully submitted that the answer is no.

Ishii et al. does appear to relate to improving the color of polyurethane compositions, but does not appear to teach the use of "3,9-bis(1,1-dimethyl-2-(3-(3-*tert*-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane" as an antioxidant component to be added to the polyol. Instead, it appears to refer to this compound as a pre-cursor for making the compound (I) shown in Col. 1, lines 56-65, to which a light stabilizer and an amine stabilizer are added. More particularly, it is stated that "The phenolic type compound . . . (I) . . . can be produced by esterification of 3-(3-alkyl-5-*tert*-butyl-4-hydroxyphenyl)propionic acid or its acid halide or acid anhydride with 3,9-bis(1,1-dimethyl-2-(3-(3-*tert*-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane...". Col. 2, lines 3-8. In the present invention, the anti-oxidant 3,9-bis(1,1-dimethyl-2-(3-(3-*tert*-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane is added directly to the polyol.

One of ordinary skill would not consider, upon review of Ishii et al., adding 3,9-bis(1,1-dimethyl-2-(3-(3-*tert*-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane directly to the polydiene diol of St. Clair et al. What would be the motivation for adding this compound directly, instead of merely considering it to be a precursor to another component?

Even if one of ordinary skill were to consider adding it directly, what type of effect might be expected in the St. Clair et al. polyurethane? For example, by adding the relatively low molecular weight (i.e., 741) compound of Ishii et al. in place of the higher molecular weight (1000-10,000) compound of St. Clair et al., what kind of discoloration, color migration or other

properties might be expected by one of ordinary skill in the art? This level of uncertainty does not equate to obviousness.

As for Duffy et al., there is no mention therein of the present invention's goal of reducing discoloration or color migration that is caused by dibutyl cresol. Instead, this reference discusses the fact that dibutyl cresol (BHT) is conventionally used as a free-radical inhibitor to stabilize polyether polyols, but the dibutyl cresol causes visible smoke during a rapid cool process. Instead of using dibutyl cresol, Duffy et al. suggests other non-volatile inhibitors, such as IRGANOX 1035 (2-2'-thio-diethylene bis (3-(3,5-di-t-butyl-4-hydroxyphenyl) propionate).

Again, when one of ordinary skill is seeking to improve upon the color fastness of known polyurethane foams made of dibutyl cresol based polyols, Duffy et al. fails to suggest a motivation for replacing the dibutyl cresol with 2-2'-thio-diethylene bis (3-(3,5-di-t-butyl-4-hydroxyphenyl) propionate). Most particularly, there is no indication as to what would happen to color fastness if this compound were added to the polyol. Also, by adding the relatively low molecular weight compound of Duffy et al. (642.9) in place of the higher molecular weight (1000-10,000) compound of as St. Clair et al., what kind of polyurethane color or other properties might have been expected by one of ordinary skill in the art? Again the uncertainty is too great to lead to a conclusion that same would have merely been obvious.

Even if one of ordinary skill were taught by Duffy et al. to substitute the antioxidant thereof for dibutyl cresol, St. Clair et al. does not appear to indicate that it uses dibutyl cresol, so there would be no motivation to make the substitution.

III. CONCLUSION

In light of the above amendments and remarks, it is respectfully submitted that claims 1-6 are now in condition for allowance.

If there are any additional fees associated with this Response, please charge same to our Deposit Account No. 19-3935.

Finally, if there are any formal matters remaining after this Response, the undersigned would appreciate a telephone conference with the Examiner to attend to these matters.

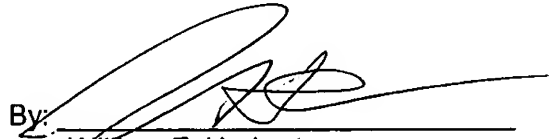
Respectfully submitted,

STAAS & HALSEY LLP

Date:

7/1/03

By:



William F. Herbert
Registration No. 31,024

1201 New York Avenue, NW, Suite 700
Washington, D.C. 20003
(202) 434-1500

**VERSION WITH MARKINGS TO SHOW CHANGES MADE -
37 C.F.R. §121(b) and/or (c)**

A. IN THE WRITTEN DESCRIPTION

Please REPLACE the written description with the SUBSTITUTE SPECIFICATION attached hereto.

B. IN THE CLAIMS:

Please AMEND claims 1, 2 and 5 as follows: (for the Examiner's convenience, all pending claims are included below):

1. (ONCE AMENDED) A dibutyl cresol-free polyurethane foam obtained by foaming a polyurethane raw material comprising:

a polyol component;

a phenolic antioxidant selected from [3, 9-bis[2-(3-(3-t-butyl-4-hydroxy-5-methylphenyl) propioniloxy)-1,1-dimethylethyl]-2,4,8,10-tetraoxapyro [5,5] undecane and] 3,9-bis(1,1-dimethyl-2-(3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5) undecane or 2,2'-thio-diethylene bis (3-(3,5-di-t-butyl-4-hydroxyphenyl) propionate] in an amount of 0.05-2.0 parts by weight for 100 parts by weight of the polyol component;

a benzotriazole UV absorbing agent in an amount of 0.1-3.0-parts by weight for 100 parts by weight of the polyol component; and

a phosphorous antioxidant in an amount of 0.5-6.0 parts by weight for 100 parts by weight of the polyol component[,

wherein the polyurethane raw material is substantially free of dibutyl cresol].

2. (ONCE AMENDED) The polyurethane foam according to claim 1, wherein the polyurethane raw material further comprises, in relation to 100 parts by weight of the polyol component, an isocyanate component (10-80 parts by weight), a catalyst (0.01-2.0 parts by weight), a foaming agent (1.0-25.0 parts by weight), and a foam stabilizer [(0.01)10.1-3.0 parts by weight).

5. (ONCE AMENDED) The polyurethane foam according to claim 1, wherein the phenolic antioxidant is selected to be only [3, 9-bis[2-{3-(3-t-butyl-4-hydroxy-5-methylphenyl)propionyloxy}-1,1-dimethylethyl]-2,4,8,10-tetraoxapyro [5,5] undecane and] 3,9-bis(1,1-dimethyl-2-(3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane.

C. IN THE ABSTRACT

N.E
Please AMEND the Abstract as follows:

A soft polyurethane foam obtained by foaming a polyurethane raw material including a phenolic antioxidant selected from [3, 9-bis[2-{3-(3-t-butyl-4-hydroxy-5-methylphenyl)propionyloxy}-1,1-dimethylethyl]-2,4,8,10-tetraoxapyro [5,5] undecane and] 3,9-bis(1,1-dimethyl-2-(3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane and/or 2,2'-thio-diethylene bis [[3-(3,5-di-t-butyl-4-hydroxyphenyl)propionate] in an amount of 0.05 - 2.0 parts by weight, a benzotriazole type UV absorbing agent in an amount of 0.1 - 3.0 parts by weight, and a phosphorus type antioxidant in an amount of 0.5 - 6.0 parts by weight for 100 parts by weight of a polyol component. Color migration and discoloration of a soft polyurethane foam are prevented.



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SUBSTITUTE SPECIFICATION
MARKED-UP VERSION

TITLE OF THE INVENTION

SOFT POLYURETHANE FOAM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part application of, and claims the benefit under 35 U.S.C. §120 of, pending U.S. Ser. No. 09/267,673, entitled "Soft Polyurethane Foam", filed on March 15, 1999.

This application also claims the benefit under 35 U.S.C. Section 119 of Japanese Patent Application Serial No. H10-68370, filed March 18, 1998, which is hereby incorporated by reference in its entirety into this application.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to a soft polyurethane foam. More particularly, the present invention relates to a soft polyurethane foam which does not cause discoloration or color migration, and which is useful for a pad material for clothing-related uses such as a brassiere pad, shoulder pad, and hanger pad, and the like.

2. Description of the Related Art

[0003] Soft polyurethane foams have good cushioning properties, and unlike cotton, they do not lose their elasticity and have a soft and good feel even after being used for a long time or repeatedly; therefore they have been widely used for a pad material for clothing-related uses such as a brassiere pad, shoulder pad, and hanger pad, and the like.

[0004] The conventional soft polyurethane foam having been produced from a polyol raw material containing BHT (dibutyl cresol) as an antioxidant, involves problems arising from the BHT, such as discoloration of the foam itself, or color migration (the cloth in contact with the soft polyurethane foam is stained). That means, when a raw material composition containing BHT is foamed to produce polyurethane, BHT remains in the foam after the foaming step, and reacts with nitrogen oxides contained in the atmosphere to yellow the urethane foam. Since BHT is sublimable, it evaporates and adheres to cloth nearby to discolor the cloth likewise.

[0005] The soft polyurethane foam discolours by the effects of ultraviolet rays as well.

[0006] Such discoloration and color migration of the foam present a significant defect of a soft polyurethane foam for clothing-related uses.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is to solve the above-mentioned conventional problems and to provide a soft polyurethane foam wherein the discoloration thereof and the color migration therefrom are prevented.

[0008] The soft polyurethane foam according to the present invention is produced by foaming a polyurethane raw material which satisfies one or more, preferably two or more, more preferably all of the following conditions (i) - (iii), and which is substantially free from BHT. (i) the polyurethane raw material includes a phenolic antioxidant selected from 3,9-bis[1,1-[dimehtyl] dimethyl-2-[(3-(3-tert-butyl-4-hydroxy-5-[methylphenyl] methylphenyl)propionyloxy)ethyl]-2,4,8,10-tetraoxaspiro(5.5)undecane and/or 2,2'-thio-diethylene bis [(3-(3,5-di-t-butyl-4-hydroxyphenyl) propionate)] in an amount of 0.05 - 2.0 parts by weight for 100 parts by weight of the polyol component; (ii) the polyurethane raw material includes a benzotriazole type UV absorbing agent in an amount of 0.1 - 3.0 parts by weight for 100 parts by weight of the polyol component; and (iii) the polyurethane raw material includes a phosphorus type antioxidant in an amount of 0.5 - 6.0 parts by weight for 100 parts by weight of the polyol component.

[0009] As noted above, the color migration of the soft conventional polyurethane foam occurs from sublimation and adhesion of BHT to cloth. According to the present invention, the antioxidant used in the raw material is changed from BHT to [3,9-bis[2-{3-(3-t-butyl-4-hydroxy-5-methylphenyl) propioniloxy}-1,1-dimethylethyl]-2,4,8,10-tetraoxapyro [5,5] undecane] 3,9-bis(1,1-dimethyl-2-(3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane and/or 2,2'-thio-diethylene bis [(3-(3,5-di-t-butyl-4-hydroxyphenyl) propionate)] to prevent the color migration. That is, the foam is substantially free of BHT.

[0010] The macromolecular phenolic antioxidant is preferably [3,9-bis[2-{3-(3-t-butyl-4-hydroxy-5-methylphenyl) propioniloxy}-1,1-dimethylethyl]-2,4,8,10-tetraoxapyro [5,5] undecane] 3,9-bis(1,1-dimethyl-2-(3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane.

[0011] As the yellowing of the soft polyurethane foam is largely affected by UV, according to the present invention, the UV absorbing agent is added to prevent the discoloration.

[0012] In addition, the discoloration of the soft polyurethane foam with NO_x and the discoloration of the soft polyurethane foam during hot press are effectively prevented by the use of the phosphorus type antioxidant.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] Embodiments of the present invention will be explained in detail.

[0014] Each of the weight values of BHT, [3,9-bis[2-{3-(3-t-butyl-4-hydroxy-5-methylphenyl)propioniloxy}-1,1-dimethylethyl]-2,4,8,10-tetraoxapyro [5,5] undecane] 3,9-bis(1,1-dimethyl-2-(3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane and 2,2'-thio-diethylene bis [[3-(3,5-di-t-butyl-4-hydroxyphenyl) propionate] described herein is calculated based on the atomic weights of C-12, H-1, and O-12.[]

[0015] According to the present invention, color migration due to the evaporation of the antioxidant is prevented by blending a phenolic antioxidant selected from [3,9-bis[[2-{3-(3-t-butyl-4-hydroxy-5-methylphenyl)propioniloxy}-1,1-dimethylethyl]-2,4,8,10-tetraoxapyro[5,5] undecane] 3,9-bis(1,1-dimethyl-2-(3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5) undecane having a molecular weight of 741 and/or 2,2'-thio-diethylene bis [[3-(3,5-di-t-butyl-4-hydroxyphenyl) propionate] having a molecular weight of 642.9 with a polyurethane raw material, therefore the polyurethane raw material becomes substantially free from BHT. These phenolic antioxidants can be used separately or in combination.

[0016] A commercially-available example of [3,9-bis[2-{3-(3-t-butyl-4-hydroxy-5-methylphenyl)propioniloxy}-1,1-dimethylethyl]-2,4,8,10-tetraoxapyro [5,5] undecane] 3,9-bis(1,1-dimethyl-2-(3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane is "AO80" and a commercially-available example of 2,2'-thio-diethylene bis [[3-(3,5-di-t-butyl-4-hydroxyphenyl) propionate] is "AO75", both of which are available from Asahi Denka Kogyo K.K.

[0017] When the phenolic antioxidant selected from [3,9-bis[2-{3-(3-t-butyl-4-hydroxy-5-methylphenyl)propioniloxy}-1,1-dimethylethyl]-2,4,8,10-tetraoxapyro [5,5] undecane] 3,9-bis(1,1-dimethyl-2-(3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane and 2,2'-thio-diethylene bis [[3-(3,5-di-t-butyl-4-hydroxyphenyl) propionate] is contained in an amount of less than 0.05 parts by weight for 100 parts by weight of the polyol component in the polyurethane raw material, the oxidation inhibition performance is weak, and the stability of the raw material itself is lowered. When the amount exceeds 2.0 parts

by weight, however, the appearance of the obtained soft polyurethane foam is inferior and the raw material cost is increased. Accordingly, the amount of the antioxidant is preferably 0.05 - 2.0 parts by weight for 100 parts by weight of the polyol component in the polyurethane raw material.

[0018] A benzotriazole type UV absorbing agent is mixed in the polyurethane raw material to prevent the yellowing of the foam by UV. Commercially-available examples of the benzotriazole type UV absorbing agent are "T-213" available from Ciba-Geigy Ltd., and "LA-31" available from Asahi Denka Kogyo K.K., and the like. Of course, similar UV absorbing agents can be used.

[0019] When the amount of the benzotriazole type UV absorbing agent contained is less than 0.1 parts by weight for 100 parts by weight of the polyol component in the polyurethane raw material, sufficient effects can not be derived from the addition, and when the amount exceeds 3.0 parts by weight, the appearance of the obtained soft polyurethane foam is inferior and the raw material cost is increased. Accordingly the amount of the benzotriazole type UV absorbing agent used is preferably 0.1 - 3.0 parts by weight for 100 parts by weight of the polyol component in the polyurethane raw material.

[0020] Conventional discoloration of the foam itself caused by NO_x or by hot press can be prevented by blending a phosphorus type antioxidant with the polyurethane raw material. Commercially-available examples of the phosphorus type antioxidant are "3010" and "1178", and the like, available from Adeka Co., Ltd.

[0021] When the amount of the phosphorus type antioxidant is less than 0.5 parts by weight for 100 parts by weight of the polyol component in the polyurethane raw material, sufficient effects cannot be derived from the addition, and when the amount exceeds 6.0 parts by weight, the appearance of the resulting soft polyurethane foam is inferior and the raw material cost is increased. Therefore, the amount of the phosphorus type antioxidant blended is preferably 0.5 - 6.0 parts by weight for 100 parts by weight of the polyol component in the polyurethane raw material.

[0022] It is preferable that the polyurethane raw material be substantially free from BHT and contain the phenolic antioxidant selected from [3,9-bis[2-(3-(3-*t*-butyl-4-hydroxy-5-methylphenyl)propionyloxy]-1,1-dimethylethyl]-2,4,8,10-tetraoxapyro [5,5] undecane] 3,9-bis(1,1-dimethyl-2-(3-(3-*tert*-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane and 2,2'-thio-diethylene bis [[(3-(3,5-di-*t*-butyl-4-hydroxyphenyl) propionate)] in an amount of

0.05 - 2.0 parts by weight, a benzotriazole type UV absorbing agent in an amount of 0.05 - 1.0 parts by weight, and the phosphorus type antioxidant in an amount of 0.5 - 6.0 parts by weight, for 100 parts by weight of the polyol component, in order to prevent both the color migration and the discoloration of the foam itself.

[0023] A soft polyurethane foam of the present invention can be produced from an ordinary raw material, according to a conventional process such as the following method, except that the polyurethane raw material contains the predetermined antioxidants, and the like, as described above. The NCO index of the raw material is preferably 90 - 120.

<Polyurethane raw material composition (parts by weight)>

Polyol component: 100 parts by weight

Isocyanate component: 10 - 80 parts by weight

Catalyst: 0.01 - 2.0 parts by weight

Foaming agent: 1.0 - 25.0 parts by weight

Foam stabilizer: 0.1 - 3.0 parts by weight

All the parts by weight of the isocyanate, catalyst and foaming agent and stabilizers are relative to the 100 parts by weight of the polyol component.

[0024] As for the polyol component, there is no particular restriction, however, those having a number average molecular weight of 2500 - 5000, an OH value of 40 - 60 are preferably used. A commercially-available example is GP3000 from Dow Polyurethane Co., Ltd.

[0025] As for the isocyanate component, there is no particular restriction, however, an organic polyisocyanate having two or more isocyanate groups in one molecule, including aliphatic and aromatic polyisocyanate compounds and their modified products is used. Examples of the aliphatic polyisocyanate include hexamethylene diisocyanate, isophorone diisocyanate, dicyclohexylmethane diisocyanate, methylcyclohexane diisocyanate and the like. Examples of the aromatic polyisocyanate include toluene diisocyanate, diphenylmethane diisocyanate, polymeric diphenylmethane diisocyanate and the like. As their modified products, carbodiimide modified substances and prepolymer modified substances can be used. Preferable polyisocyanates according to the present invention include aromatic polyisocyanates or aromatic polyisocyanate modified products, in particular, diphenylmethane isocyanate, toluene

diisocyanate, diphenylmethane diisocyanate and the like are preferred.

[0026] The foam stabilizer may be silicone oil, or the like.

[0027] As for the foaming agent, any foaming agent which can be used for production of a polyurethane foam can be used. Examples thereof include methylene chloride, flon type compounds such as trichlorofluoromethane and dichlorodifluoromethane, as a low boiling point inactive solvent, water, acid amides and nitroalkanes and the like as a substance which generates a gas by liquefied carbon dioxide gas reaction, sodium hydrogen carbonate, ammonium carbonate and the like as a substance which generates a gas by heat decomposition. Among these, methylene chloride, water and the like are preferred as the foaming agent.

[0028] As a catalyst, any catalyst which can be used for an ordinary urethane foam production can be used. Examples thereof include tin type catalysts such as dibutyltin dilaurate, stannous octoate, and tertiary amines such as triethylamine and tetramethyl hexamethylenediamine.

[0029] The polyurethane foam of the present invention may contain a surfactant, a flame retardant, or other assistants, if necessary. As a surfactant, a silicone type surfactant can be usually employed. As a flame retardant, an organic powder such as urea and thiourea or an inorganic powder such as a metal hydroxide and antimony trioxide can be used in addition to the conventionally known flame retardant such as tris (2-chloroethyl) phosphate, tris (2,3-dibromopropyl) phosphate, and the like.

[0030] Examples of other assistants include a coloring powder such as a pigment and dye, a powder such as talc, graphite, glass short fiber, and other inorganic fillers, and an organic solvent.

EXAMPLES AND COMPARATIVE EXAMPLES

[0031] Without further elaboration, it is believed that one skilled in the art, using the preceding description, can utilize the present invention to its fullest extent. The following embodiments are, therefore, to be construed as merely illustrative, and not limitative in any way whatsoever, of the remainder of the disclosure.

[0032] The present invention is further illustrated by the following Examples and Comparative Examples.

Examples 1 - 7, Comparative Examples 1 - 10

[0033] Polyurethane raw materials having the compositions shown in Table 1 were foamed at

25°C according to an ordinary process to produce soft polyurethane foams. The color migration, discoloration by UV and discoloration by NO_x of the produced soft polyurethane foams were examined by the following methods and the results are shown in Table 1.

<Color migration>

[0034] A urethane foam was wrapped in a polyester cloth and allowed to stand at 50°C for 48 hours, then the polyester cloth was exposed to 50 ppm NO_x for 2 hours, and allowed to stand at 50°C for 30 days. Then YI value (based on a white plate) of the polyester cloth was measured by “ZE2000” available from Nippon Denshoku Sha K.K. The larger the YI value, the bigger the degree of discoloration.

<Discoloration by UV>

[0035] A polyurethane foam was irradiated with UV for 9 hours using one carbon arc and the YI value based on the white plate was determined by “ZE2000” available from Nippon Denshoku Sha K.K.

<Discoloration by NO_x>

[0036] A polyurethane foam was allowed to stand in an atmosphere containing NO_x of 500 ppm for 2 hours then the YI value based on the white plate was measured by “ZE2000” available from Nippon Denshoku Sha K.K.

	Examples							Comparative Examples											
	1.00	2.00	3.00	4.00	5.00	6.00	7.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00		
Polyol *1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00		
Antioxidant *2	0.30	0.30	0.30	0.30	0.30	0.30													
Antioxidant *11							0.30												
Antioxidant *3								0.30	0.30	0.30	0.30	0.30	0.30						
Antioxidant *4	5.00	2.00	5.00	2.00					5.00	5.00		0.30							
Ethanol 330														0.30					
Cyanox 2246															0.30				
Irganox 1010																0.30			
Irganox 1078																	0.30		
UV absorbing agent *6	2.00	1.00			2.00	1.00	1.00	2.00		2.00			0.05	1.0	1.0	1.0	1.0		
Water	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.6	3.6	3.6	3.6		
Amine catalyst *8	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25		
Amine catalyst *7	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25		
Foam stabilizer *8	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.2	1.2	1.2	1.2		
Tin catalyst *9	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.5	0.5	0.5	0.5		
Isocyanate *10	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60	60	60	60		
Color migration	0.13	0.22	0.50	0.48	0.42	0.55	0.40	35.21	33.38	29.31	31.06	30.55	32.07	0.45	0.49	0.48	0.52		
UV discoloration	10.22	15.13	26.60	19.61	19.52	18.43	21.33	21.05	30.26	12.76	59.87	54.57	54.17	31.42	30.55	25.86	30.85		
NOx discoloration	13.08	15.11	19.03	20.55	33.31	30.84	37.83	32.47	20.22	14.05	60.23	58.94	57.12	48.23	45.11	39.99	50.23		
Polyurethane foam raw material compositions (wt parts)																		YI value	

*1 GP 3000 available from Dow Polyurethane Co., Ltd (no antioxidant is added)

*2 Phenolic antioxidant, [3,9-bis[2-{3-(3-t-butyl-4-hydroxy-5-methylphenyl) propioniloxy}-1,1-dimethylethyl]-2,4,8,10-tetraoxapyro [5,5] undecane] 3,9-bis(1,1-dimethyl-2-(3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionyloxy)ethyl)-2,4,8,10-tetraoxaspiro(5.5)undecane, AO80, available from Asahi Denka Kogyo K.K. (molecular weight of 741)

*11 Phenolic antioxidant, 2,2'-thio-diethylene bis [(3-(3,5-di-t-butyl-4-hydroxyphenyl) propionate) AO75, available from Asahi Denka Kogyo K.K. (molecular weight of 642.9)

*3 Phenolic antioxidant, BHT, available from Asahi Denka Kogyo K.K. (molecular weight of 220)

*4 Phosphorus type antioxidant, Adeka 3010, available from Asahi Denka Kogyo K.K.
(molecular weight of 503)

*5 Benzotriazole type UV absorbing agent, T-213, available from Ciba-Geigy Ltd.

*6 Triethylene diamine, DABCO-33LV, available from Sankyo Airproducts Co., Ltd.

*7 A133, available from Sankyo Airproducts Co., Ltd.

*8 L6202B, silicone oil available from Nippon Unicar Co., Ltd.

*9 U-28, available from Nittoh Chemical Industries Ltd.

*10 tolylene diisocyanate, T-80, available from Dow Polyurethane Co., Ltd

[0037] Table 1 shows that the discoloration of the foam itself or the color migration can be prevented according to the present invention.

[0038] The preceding examples can be repeated with similar success by substituting the generically or specifically described reactants and/or operating conditions of this invention for those used in the preceding examples.

[0039] As described above, according to the present invention there is provided a soft polyurethane foam which is free from problems of discoloration of the foam itself or color migration, and which is useful for a pad material for clothing-related uses.

[0040] The foregoing is considered illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described. Accordingly, all suitable modifications and equivalents may be resorted to that fall within the scope of the invention and the appended claims.